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ABSTRACT

Teaching is a profession where aspiring practitioners enter the field with preconceived beliefs and conceptions about teaching and learning acquired during the 12 years or more they spent within the educational system. The purpose of the study was to examine the influence of an educational reform environment on the development and retention of beliefs and knowledge of student teachers during the practice teaching segment of their teacher preparation program. The subjects were two student teachers placed in the State Project for Reform in Science Education (SPRSE) sites for their student teaching experience. Data collection methods included interviews and observations. Results indicate that student discipline issues were a major factor which dispelled many of the student teachers' beliefs concerning increased student involvement in the classroom and created an issue they could not resolve. The most significant determining factors of how the student teachers taught were their comfort with the subject matter and materials and concerns of classroom management and student control. It was concluded that the experience with the reform project had a negative effect on the student teachers' attitudes toward educational reform efforts and teaching in general. Implications for teacher education are discussed. Contains 19 references. (JRH)

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STUDENT TEACHERS: Outsiders in Curriculum Reform?

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Paper presented at the 1996 Annual Meeting of the National Association for Research in Science Teaching, St. Louis, Missouri.

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Introductory Remarks on the Importance of the Education of Teachers from the Pre-service Years and Continuing Throughout Their Professional Careers.

> Educational change involves *learning* how to do something new. Given this, if there is any single factor crucial to change it is professional development. In its broadest definition professional development encompasses what teachers bring to the profession and what happens to them throughout their careers...the educator as life-long learner is the key to future reform (Fullan, 1991, p.289).

Other researchers (Buttery, Haberman, and Houston, 1990; Sizer, 1987) have identified the need for reform in teacher education to go "hand-in-hand" with reform in the schools. But there is a minimal amount of research in teacher education, especially field experiences or student teaching. There exists a need to know what is occurring within the context of field experience and, also, a need to know what *should* be occurring (Guyton and McIntyre, 1990).

Teaching is a profession where aspiring practitioners enter the field with preconceived beliefs and conceptions about teaching and learning acquired during the twelve years or more they spent within the educational system. Lortie (1975) calls these prior experiences, where students form their ideas of what should go on in the classroom, the "apprenticeship of observation". Research has revealed that students, including pre-service teachers, filter new information through their existing knowledge and beliefs (Borko and Putnam, in press). Therefore, what aspiring teachers learn from teacher education is determined, at least in part, by the knowledge and beliefs they bring with them into teacher education (Calderhead and Robson, 1991; Grossman, 1991). Since these impressions are instilled in the students at an early age they are powerful and hard to dispel, as Confrey (1990) demonstrated with students' fundamental conceptions about science and mathematics.

This study is based on the philosophy that learning to teach, like all other learning, is constructive. It is a process of inquiry--the task of relating what one has encountered to one's current ideas (Strike and Posner, 1985). Pre-service teachers interpret events on the basis of their existing knowledge, their prior experiences, beliefs, and dispositions. From this perspective, in order for learning to occur there must be changes in the learner's mental organization, structure, and processes (Borko and Putnam, in press).

Constructivist learning focuses on the creation of a learning environment instead of concentrating on a body of facts (Borko and Putnam, in press). Looking at teaching future teachers from this perspective entails concentrating on the learning environment that exists at the field site.

According to cognitive theorists it is essential that an environment conducive for learning not be abstract and detached but closely connected with its physical and cultural contexts (West and Pines, 1985). For knowledge to be useful for teaching it must be linked to the context in which it is to be used. Methods classes, which present theory and associated teaching strategies detached from the classroom context, often are unsuccessful in creating teachers who teach differently. The student teaching site has the possibility of bridging the gap between theory and practice because it can provide this link between teaching and the context in which it is used.

Therefore, if teachers are to teach differently they must be exposed to situations which are different, often subtly different, from their own traditional school experiences. According to Wood, Cobb, and Yackle (1990), not only new teachers, but teachers in general, cannot make changes in their knowledge and beliefs until they see something problematic in their own classroom. Educational reform sites that advocate change in educational practices and teaching strategies are believed to hold the best promise for changing the knowledge and belief systems of aspiring teachers. In this study it was my intention to test this belief in a context where reforms are demonstrated and new teachers have the opportunity to see that "something else" works, as well as actively participating in the process of making these new ideas work. Information gained from this study can be used to improve teacher education on a larger scale.

Key indications that change has occurred are teacher knowledge and teacher beliefs. From studies of expert performance and problem solving in various domains outside education, the ability to perform as an expert has been attributed to the accumulation of richly structured and accessible bodies of knowledge (Glaser, 1984). Looking at the development of knowledge structures related to teaching, learning and content areas, and how they are organized by student teachers during practice teaching can give researchers an indication of the individual's ability to perform as a teacher. Teachers' beliefs inform researchers of the teacher's view of teaching and learning. A question to be answered is: Can an environment of educational reform foster the development of more structured and accessible bodies of knowledge and change teacher beliefs?

The purpose of this study is to examine the influence of an educational reform environment on the development and retention of beliefs and knowledge of student teachers during the practice teaching segment of their teacher preparation program.

According to Bullough, Knowles and Crow (1992) and Yin (1989) case studies are valuable when investigating situations

where the researcher has little control in real-life situations. This method enables the researcher to preserve the integrity of the subjects' experiences and meanings as well as encouraging sensitivity to changes within the context of the experience without being narrowly bound to preconceived courses of experimentation. In addition Yin states that when "how" or "why" questions are being asked and the focus is on a contemporary phenomenon within a real-life context, case studies are the preferred strategy.

Methods

Sample

Two student teachers placed in The State Project for Reform in Science Education (SPRSE) sites for their student teaching experience volunteered to participate in this research study. SPRSE is the state's interpretation of National Science Teachers' Association (NSTA) Scope, Sequence and Coordination (SS&C).

Both student teachers were young female college students in the final semester of a four-year middle grades teacher education program at Western State University[1]. Each had entered college immediately upon high school graduation and neither had worked at any other job or career prior to entering the teacher education program.

Description of the Site

The school district serves approximately 18,500 students in an urban environment of 50,000 people and surrounding smaller communities. The students are distributed throughout 19 elementary schools, 8 middle schools and 4 high schools.

The primary industry in Lincoln County has shifted from agriculture to manufacturing as several major industries have moved into the area, bringing manufacturing jobs and changing the composition of the population. The original black minority population worked the farms and their children generally left the school system as soon as the law permitted. Factories have attracted a new minority population to the area who live in urban projects and trailer parks in the city. Although they were originally attracted to the area because of jobs, many are now living on welfare and their children have swelled the ranks of the local school system.

Each of the district schools has a 50% minority population due to a federal mandate to racially integrate. The Black River forms a natural boundary within the district, dividing the poor

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[1]The names of all persons, places, and institutions are pseudonyms.

and richer populations of the county. North of the river is a poor district with a high minority population dependant on welfare and living in trailer parks. South of the river one finds the majority white population residing in suburban housing developments with names like Camelot. One student teacher, Laura, was placed in Gateway Middle School, north of the river, the other student teacher, Marilyn, was placed in the more affluent area south of the river.

Fairview Middle School is a bustling middle school of 800 students located in the sleepy little town of Cedarville. The school's students are from families which are a composite of low income city dwellers, middle income suburbans and the local rural and small town citizens. Students are bussed from an adjacent metropolitan area of 50,000 people. The school population is evenly distributed among the three grades (254 in grade 6, 252 in grade 7, and 242 in grade 8) and reflects the 50% minority composition of the district.

Gateway Middle School is located north of the Black River in the industrial section of a city of 50,000 people. A major four-lane divided highway runs parallel to the railroad tracks across from the school and carries trucks and other traffic from the surrounding factories and warehouses. Hidden from the view of the casual observer by dense foliage is a network of low-income trailer parks. Most of the school population calls this trailer park environment home. Very few students come from a traditional family. Drugs, crime and welfare are major elements of their society. Gateway Middle School's student population of 636 is evenly divided among the three grades (193 in grade 6, 213 in grade 7 and 211 in grade 8). Despite a federal mandate to integrate all schools in the district the school is predominately black (60.2%).

Although both Gateway and Fairview Middle School used the same science reform program, SPRSE, it looked different at each site due to characteristics of the school, the composition of the teaching staff, and the student population. Because of the school's past history of behavioral and attendance problems Gateway Middle School placed an emphasis on student control at all levels throughout the school. When the sixth and seventh science teachers were interviewed concerning their view of SPRSE (the program is not used in the 8th grade) only one teacher was completely in favor of the new science reform program. The other teachers liked some individual parts and/or activities but in general they felt that the high level of student involvement led to class management and discipline problems. They were also concerned that students did not learn enough content in SPRSE and reported that they used the science reform lessons periodically. In general they relied on old textbooks and other written materials for science "facts."

Description of the Teacher Education Program

The middle grades teacher education course of study at WSU is a four-year baccalaureate degree program, which has been in place for 5 years. The program requires a concentration in two academic areas (18-24 semester hours each). The two student teachers in this study both had concentrations in math and science.

Data Sources

Student teachers conceptions of teaching/learning and subject matter were obtained through interviews. Classroom observations documented by a written observational record and audiotapes were conducted in order to ascertain teacher practices. Later these two sets of data were compared in an effort to determine the degree of consistancy between beliefs and practice. I also conducted interviews with cooperating teachers, university supervisors and university methods class instructors at various stages throughout the student teaching experience. A chronological account of data collection is presented below.

Background Information. As part of a previous case study I obtained various components of the educational reform, Scope, Sequence, and Coordination (SS&C), from National Science Teachers Association's (NSTA) and The State Project for Reform in Science Education's (SPRSE) literature; classroom observations of project classrooms; and interviews with university SPRSE personnel, pilot teachers and school and district administrators. Other data, such as printed student handbooks, school newsletters, curriculum guides, and standardized student test scores were collected and analyzed to develop a picture of the school site.

Initiation of study. Prior to beginning the actual student teaching experience, each subject composed a journal entry describing her own personal beliefs about teaching and learning, including a metaphor of how she saw herself as teacher. Each pre-service teacher then diagramed a content teaching area, listing the major concepts and the interrelationships among them. (Originally I requested the student teachers diagram the content area they would be teaching. When they were unable to perform this task, I asked them to choose the science subject matter area in which they had the most confidence.) The subjects performed this same task with what they perceived were the important elements and concerns about teaching. Immediately following this exercise I conducted an interview discussing and clarifying the journal entries and the two diagrams.

Prospective student teachers participated in a classroom management class during the first five weeks of the student teaching experience. Prior to observing this class I interviewed the instructor to determine his beliefs about teaching, learning

and the teaching of science; and the goals and objectives of the class.

Throughout the study. After each student teacher had assumed responsibility for a class I scheduled three observational periods spaced at regular intervals throughout the field experience; beginning, middle and end. Observational periods varied from a minimum of one week to a maximum of three weeks. (The length of each visit was determined by the schedule of the school and the student teacher.) Classroom observations targeted teacher explanations and demonstrations, the representations used, the assignment of student tasks, and teacher-student interactions.

During the periods of classroom observation I conducted informal interviews with the students; asking them their impressions of the class, what they liked and disliked about the lessons, and what they would like to see done differently. I also asked informal questions of the cooperating teachers, administrators, and other staff members concerning their impressions of the reform project and the relationship between the project and student teaching.

For one school day I shadowed each student teacher in order to obtain a "snap-shot" of a typical school day from her perspective. Besides observing classes I attended meetings, followed the student teacher during "hall duty" and participated in the "lunch room experience."

Throughout the semester student teachers provided classroom materials (tests, quizzes, worksheets, etc.) they had constructed during the field experience, as well as copies of their lesson plans. In addition each student teacher kept a journal reflecting on her experiences.

Conclusion of the study. I conducted a second formal interview of the student teachers upon the conclusion of the field experience. The focus and structure of the interview was similar to the introductory interview. I began each interview by asking the student teacher to draw two diagrams (the major science subject matter concepts and their relationships, and the major concepts related to teaching and learning) similar to those constructed at the beginning of the study.

I then referred to the initial student teacher interview and directly asked the subject if she still saw herself as _____ (the metaphor used in the journal entry)? Why or why not? In addition I asked her to describe any incidents which changed her viewpoint.

I continued through the original journal entry asking the student teacher to compare her original stated beliefs with her

current stated beliefs. The subject was asked to address any events within the first part of field experience that have either reinforced her beliefs or have caused her to doubt or change her ideas about the subject matter, and/or teaching and learning. Next I asked the student teacher to give an example of practice that illustrates her view of the ideal class.

I conducted final interviews with each cooperating teacher and university supervisor at this time. They were asked to reflect over the past semester and give their impressions of each student's experience. Periodically throughout the semester, I read the student teachers' journals and took notes on the contents. At the conclusion of this study copies of written journals and audiotaped journals were provided to me. I also kept a personal journal of events and impressions throughout this study.

Results

Yin (1989) asserts that the preferred analytic strategy is to follow the original theoretical propositions that led to the case study. During the formal analysis stage I attempted to follow this strategy. I reread the original research questions and formed a domain and preliminary taxonomic analysis based on these questions. The domains were then used to construct the descriptive framework of the cases.

In order to determine the depth and breadth of the reform at each site I charted the features of each reform effort on a matrix and listed differences between features described in the Scope, Sequence and Coordination literature and the reality of the school site. My next step was to chart the student teachers' involvement in the reform at each site.

One of my original objectives was to chart the development of the student teachers' beliefs, and practices during the student teaching experience. In order to accomplish this task I listed student teachers' behaviors and classroom practices (e.g., lecture, demonstrations, group discussions, hands-on activities) throughout the student teaching experience. I then matched their practice with their stated beliefs and documented any changes in stated beliefs and the resulting classroom practice. For example, if the student teacher stated she believed hands-on activities increased student learning, I recorded the frequency of hands-on activities included in classroom practice--from observations and lesson plans. If these activities occurred infrequently, the inconsistency was noted. As the semester proceeded if the student teacher made a statement reflecting a change in beliefs or a change in teaching behaviors it was noted (e.g., the student teacher lectured more frequently with a decline in student participation) these changes were also recorded for the purpose of addressing them in later interviews

with the student teacher.

My next step was to match patterns predicted from the conceptual framework, literature review, and pilot study with patterns identified in the case studies. I then expanded the pattern-matching strategy to include explanation-building (Yin, 1989). For example, when I found that the collaboration observed in the pilot study was not present at either research site, I looked for similarities and differences across the sites which could explain the reason for this divergence.

I compared the two case studies of this research project with each other, and with the pilot study in order to generate alternate explanations and create a cross-case analysis. In addition I used the original propositions generated from the pilot study and review of the literature to compare the sites and to provide reasons for any differences.

In the following sections I endeavor to generate a collage of student teacher beliefs, subject matter knowledge, classroom practices, and the interrelationships of all three. When possible I use the words of the participants in this study and paint a picture of the classroom using vignettes generated by classroom observation. I begin the story with Marilyn, a student teacher placed in a 7th grade science class at Fairview Middle School.

Student Teacher Beliefs

Marilyn

During the pre-student teaching interview I asked Marilyn to give a metaphor of a teacher. Although she could not think of one, she did describe her view of the perfect teacher.

> Interesting...interesting. I think you should make your classes interesting. I don't think it should be just textbook-styled. You should bring the students into your class. It should be inviting... and they should not just walk into class and it just be the same thing everyday. It should be interesting. It should be fun, not routine. So I think the teacher should be interesting.

Marilyn elaborated and talked about some of the teaching methods she would use.

> Cooperative learning...and...and forums. Set up forums in the classroom. And um...um... I can't think of the word. But set your class up in circles. Talk to the students and make them feel welcome. Make the class atmosphere fun. And...and... put posters up everywhere and make everything enjoyable. And when you teach, don't just stand up in front of the class and lecture. Bring the students in and maybe...sometimes, have them get up in front of the class

and lecture. Have them get up there and talk about a subject. Make them welcome and just have fun. Don't make it teacher-oriented but student-oriented. That's what I'm trying to say.

In addition she discussed the importance of not overwhelming the students with content and pacing the presentation to meet the individual needs of students. Although she did not use the word, tracking, she said she did not believe in "mixing everybody together." Students should be grouped according to ability level - but teachers should still individualize the instruction based on each student's needs. In conclusion Marilyn drew a diagram representing her view of student learning and the interaction of all the factors that effect student learning (Figure 1).

Second visit When I arrived on site for my second round of visits Marilyn was absent. Connie, her cooperating teacher, related that Marilyn was having serious problems with classroom discipline, subject matter knowledge, and lesson planning. Communication problems had developed between Marilyn and her cooperating teacher. Connie said that she just stopped talking to Marilyn because she failed to follow instructions to improve her teaching.

Upon returning Marilyn revealed that she had gone home to discuss her problems in student teaching with her father. She was having serious reservations about continuing in the program because student teaching was nothing like she expected. She had decided to return to student teaching in order to graduate, but not to teach. Marilyn described the source of her discomfort with teaching.

> The discipline problems and the students just aren't interested. You plan and you try all kinds of things but they just don't care, and you hear "I don't understand" fifty times a day.

Later I asked Marilyn about her ideas concerning teaching.

> I would use less activity. It's pretty well all activity-based now. I'd use less and use a textbook. I'd write on the board what the kids really need to know. I feel that that should be enough.

In response to my question, "From your experiences how do you think students learn?" Marilyn replied.

> "Kids don't learn!"

Frustrations at not being able to control the class colored Marilyn's beliefs about teaching. She was no longer thinking about the reform program or the best way to teach; she was only

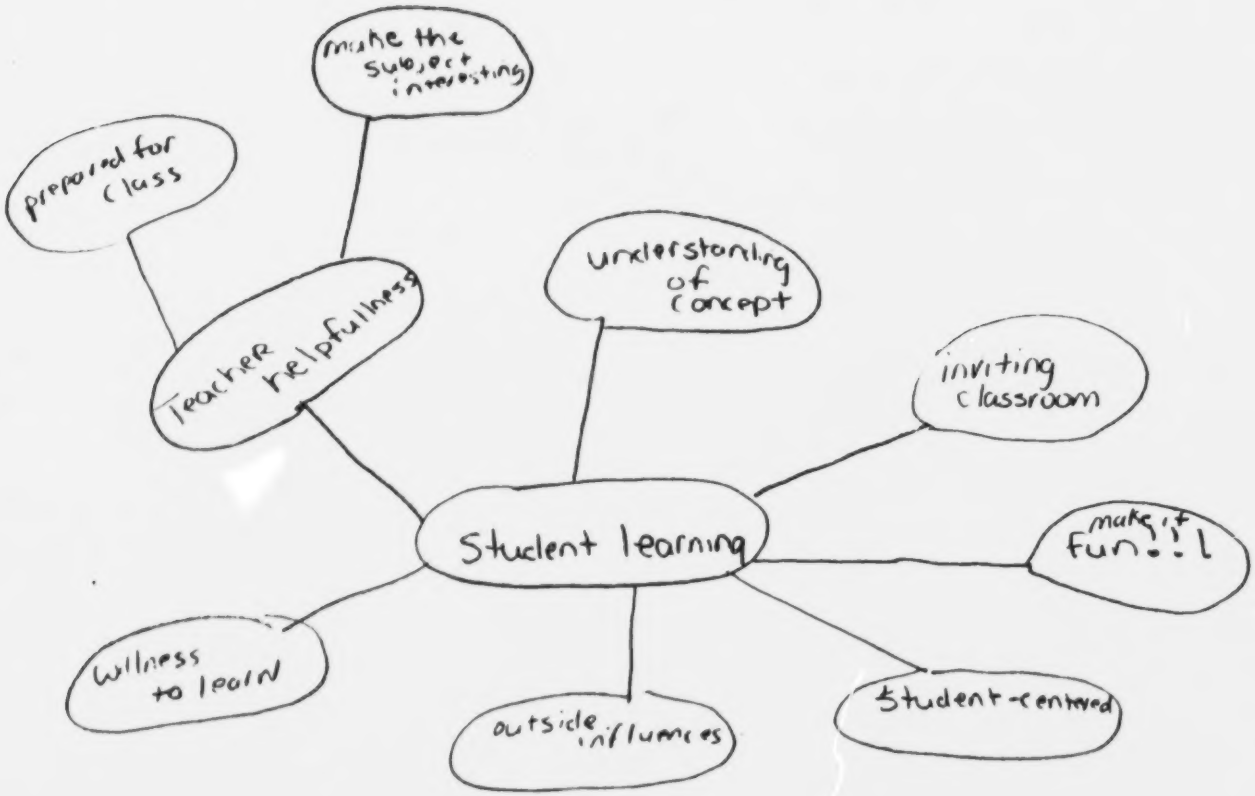

Figure 1

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concerned with survival in the classroom. This frustration was evident in her journal entry the following day.

> Today was a terrible day because I felt really bad. The student [sic] were not listening to anything I said today. I felt they could not hear anything that I was saying. I am so upset and it is making me think again about being a teacher. I like to teacher [sic] the material but the major responsible [sic] of the teacher is the discipline.

During the three weeks which elapsed between my second and third visits to the site, Marilyn did not teach any classes. Her cooperating teacher and university supervisor relieved her of all teaching responsibilities. She worked independently, researching the subject matter and planning the science classes she was expected to teach later in the semester.

At the end of the student teaching experience Marilyn supplied a metaphor of a teacher.

> Yes, a disciplinarian. Basically that's what I believe. There's not much learning going on, just disciplining, asking them to be quiet and calming them down. They come to your classroom and don't know how to behave. I think teaching and learning are miles apart. I mean, you can try to teach but it seems like nothing gets across to them no matter what you do. I don't think that students today want to learn. I feel that they'd rather just sit there and do what they want to do rather than sit there and try to learn anything.

Then Marilyn diagramed her view of teaching and learning. She drew two circles, one for teaching and one for learning, and wrote "miles apart" between them. Under the diagrams she wrote the phrase, "Student [sic] today do not want to learn." (figure 2).

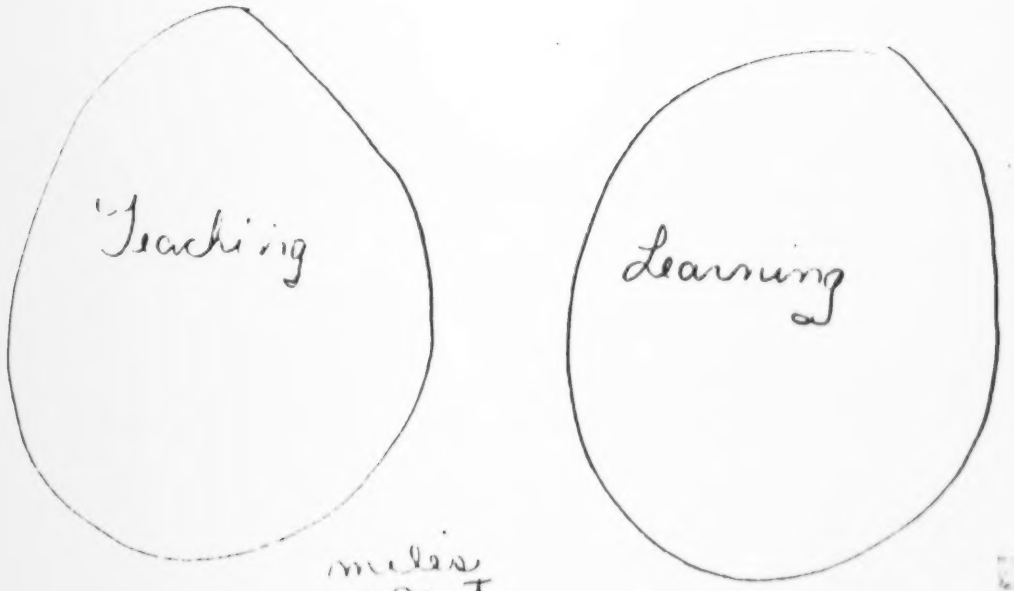
Marilyn expressed her belief that the teacher rarely makes a difference when it comes to student learning. The few students who want to learn, learn despite all obstacles. They listen to the teacher, focus on the teacher and they study on their own.

Marilyn felt that having the students do activities and work in groups--as they do in SPRSE lessons--leads to discipline problems and a loss of class control.

Laura

The other student teacher, Laura, began her student teaching experience at the same time as Marilyn, but on the other side of the river. During the first interview Laura described her "ideal" class as the students being actively engaged in

Teaching & Learning



Students today do not want to learn.

Figure 2

activities and experiments because "they remember better when they do it." She wanted to make her class "inviting" and friendly "so that they could come to me with their problems." Laura described a teacher as...

> A doctor or the mother of an animal, always looking out for and watching over the students.

She said that her classes would be neither student-centered nor teacher-centered.

> From what I've seen student-directed classes are a disaster. I would have student input but it would be limited. I would have a class that was in-between. The teacher would be in charge but the students would have some input.

Laura diagramed her view of teaching and student learning and the interaction of all the factors that effect student learning. (See Figure 3).

She drew student learning in the center of the page with lines radiating from it to represent the eleven factors that she believed influenced student learning. Five of these factors involved the students' motivation to learn: new, fun, exciting, interest (connection to everyday life), and desire.

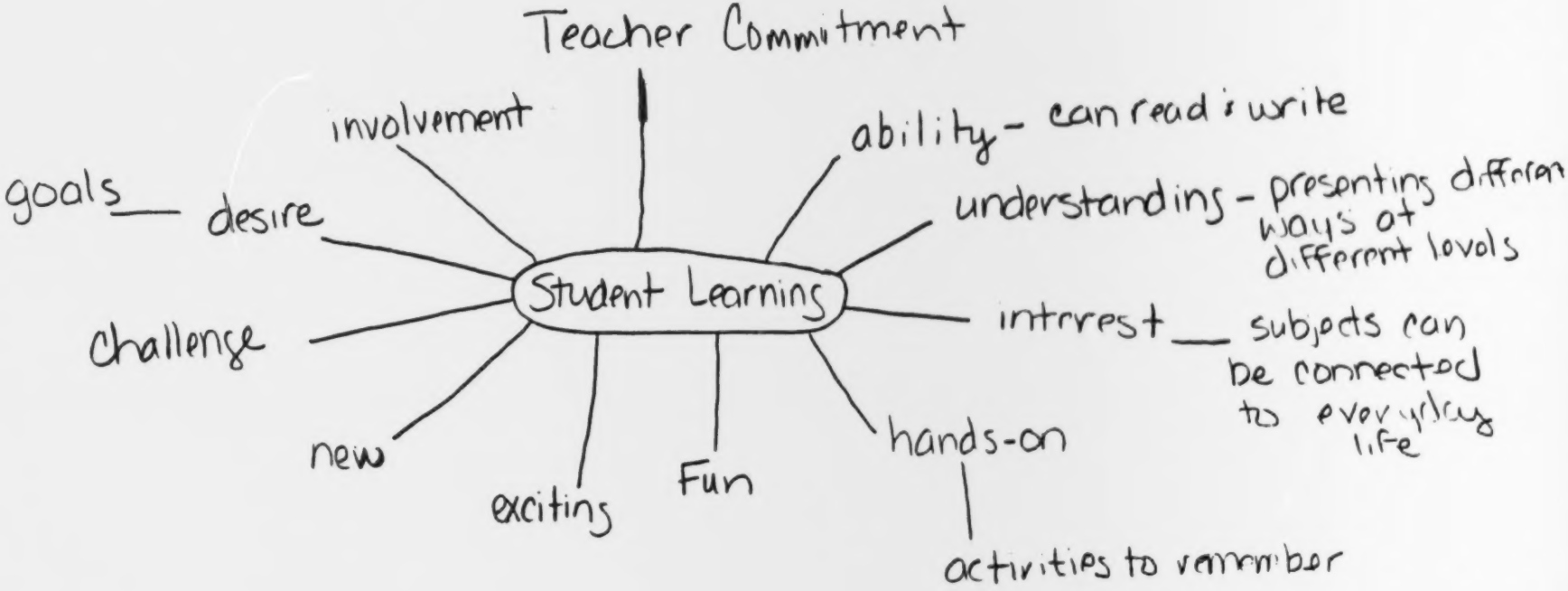
After Laura had been teaching for two weeks, she remarked that she was enjoying the student teaching but she was concerned about the lack of a textbook and equipment for doing SPRSE activities. She related that she had lost some of her enthusiasm about teaching science.

> It's hard to determine if the students got the concepts and also harder to plan. I like math because it's more structured, easier to test and plan.

Like Marilyn, Laura was concerned with discipline problems. "...the kids talk a lot and I often have problems getting them back." Discipline was a major problem when using cooperative groups.

> These kids aren't use to cooperative groups so they talk or want to want to work with others in other groups.

Toward the end of the student teaching experience Laura used Project Wild lessons. Previously she had attended a ten hour training session and was certified to teach Project Wild. Her classes became more student-centered and there was a decreased reliance on textbook definitions and notes. When she did present definitions and notes it was usually after the students had derived their own examples and definitions--instead of at the


Teacher Commitment
involvement
ability - can read & write
goals
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understandings - presenting differan ways of different levels
Student Learning
challenge
intrrest
subjects can be connected to everyday life
new
exciting
Fun
hands-on
activities to remember

Figure 3

beginning of the class as she had done earlier this semester.

At the conclusion of the student teaching experience Laura gave her same metaphor of a teacher. "I still agree that a teacher is like a mother or a babysitter, especially at this age."

Also Laura redrew her diagram of teaching and learning. She began by writing good teaching in the center of the page, circling these words and drawing lines radiating outward from the words "good teaching" to all the ingredients she felt went into "good teaching." (See Figure 4).

Laura recalled her experiences during this past semester and related how she thinks students learn.

> Kids learn by doing. If they do an activity or an experiment ... and then being quizzed on it everyday. Drill and practice, that's how I learned.

Keeping this view of how students learned, she described what she did in her classes.

> Well, I don't do it everyday, but as Dr. Shearer said, focus on the review. I'll have them go over what I want them to know at the beginning (of class) like definitions, and also a lot of hands-on activities.

Laura said her view of teaching had changed over the semester. She related that she, like Marilyn, did not realize the struggle to keep students' attention and the amount of energy that middle school students seem to possess. Although her original view of teaching was never totally student-centered she moved even closer to a teacher-controlled model.

> There's a lot more to it. I think it would be easier to teach at a higher level. But at this level (6th grade) you have to always be calming them (students) down and getting them to be quiet ... You have to spend a lot of time on class control and discipline.

She related her views of SPRSE.

> Well, I like some things, some of the topics. But I think the students should have a pamphlet of resources or something they can take home. I can't go and look at all the resource books, so I don't know what they're getting out of each book. It would take me forever to check every book. They need something in common, so I know what they're getting.

She felt SPRSE required a lot of extra work. She recounted

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Figure 4

that she went to the library and to WSU for extra materials, spent her free time "cruising the halls for materials to use in the labs." If given a choice she would use some of the SPRSE materials, but not exclusively. She felt that students need to read a textbook for some information and said that some SPRSE activities were unrealistic--taking students on field trips or to a pond.

When Laura was asked to describe her "best" teaching experience, she related that she had not had any really good experiences teaching science. Her "best" teaching experience was the math class when she introduced integers. The students used two color counters to explain positive and negative integers. She felt it was the "best" class because she was able to determine what the students understood.

At the end of the final interview I asked Laura her plans for the future. To my surprise she expressed reservations about her future as a teacher.

> I think I'll teach for awhile, but I'm not sure what I'll do. It's a lot of work for little money. Of course that's not why you teach. I'm thinking about going into some area of medicine. I was in that but I left because I didn't like the chemistry. But I was young and didn't want to study. So I'm thinking about going back into it. I don't know for sure.

Subject Matter Knowledge

Marilyn

When I first interviewed Marilyn she stated that of her two concentrations, math and science, she felt the most prepared to teach science. She was worried that, although she personally could solve math problems, she would have a hard time "getting it across to the students." She believed she was better prepared to translate her personal science knowledge into science for children.

Her collegiate subject knowledge preparation in science included the following: two semesters of chemistry; two semesters of biology; and one semester of microbiology. Since she did not list any physics or physical science courses, I asked Marilyn if she felt comfortable teaching her first science unit, forces and motion.

> Not comfortable, not really comfortable at all... because Dr. Baker's class was at the same time as the physics class so I didn't get the physical science class at all. I'm not strong in that at all so I'm going to have to do a lot of my own research. I'm not strong in that at all so I'm probably going to have to go back to my professors and ask them for help and advice because I'm

not that strong at all.

When Marilyn was asked to diagram the subject matter area she would be teaching, she said she could not even begin to perform such a task. Instead she chose to draw a diagram depicting important concepts in biology and their relationships. (Figure 5).

Marilyn talked about her conception of biology as she drew.

> The different parts of biology would be the physical parts, the chemical parts, when you talk about the Krebs Cycle. And then if it was my lesson plan for the day I would go out and draw the Krebs Cycle. In biology there's three parts to it. There's the physical. You talk about the physical parts, the bones and such. Then there's the chemical parts, the Kreb's Cycle. So I think there's your physical parts, that's your body. You have your chemical parts, that's inside of you, and then you have your outside. And then how you interact with the environment. It's like biological interaction. So that's what I think of biology.

After teaching science for a week, Marilyn's cooperating teacher expressed frustration with Marilyn's efforts. She reported that when students asked Marilyn a question, "she does not know how to respond. She just continues like it wasn't even said."

When Marilyn returned to teaching at the end of April (after being relieved of her teaching responsibilities) she taught the unit on weather. She began her first class by telling the students, "The sky is alive." Although she said she felt more comfortable with this unit, I noticed numerous errors in content. On one occasion when she was constructing a diagram of the layers of the atmosphere on an overhead transparency, she was stumped concerning where to place the ionosphere. A student had to rescue her. On another occasion the students did an activity to determine the oxygen content of the atmosphere. The cooperative groups gave results ranging from 31% to 46% for the percentage of oxygen in the air. Marilyn did not know how to explain the discrepancy between these results and the textbook figure of 20-21%. She explained the difference by stating:

> Also in the book when talking about 21%, it's an average for all the layers. Therefore the lower you are in the atmosphere the more oxygen.

She also asked the class the following question:

> I told Brian that he has air pressure pushing down on him, why doesn't he explode?

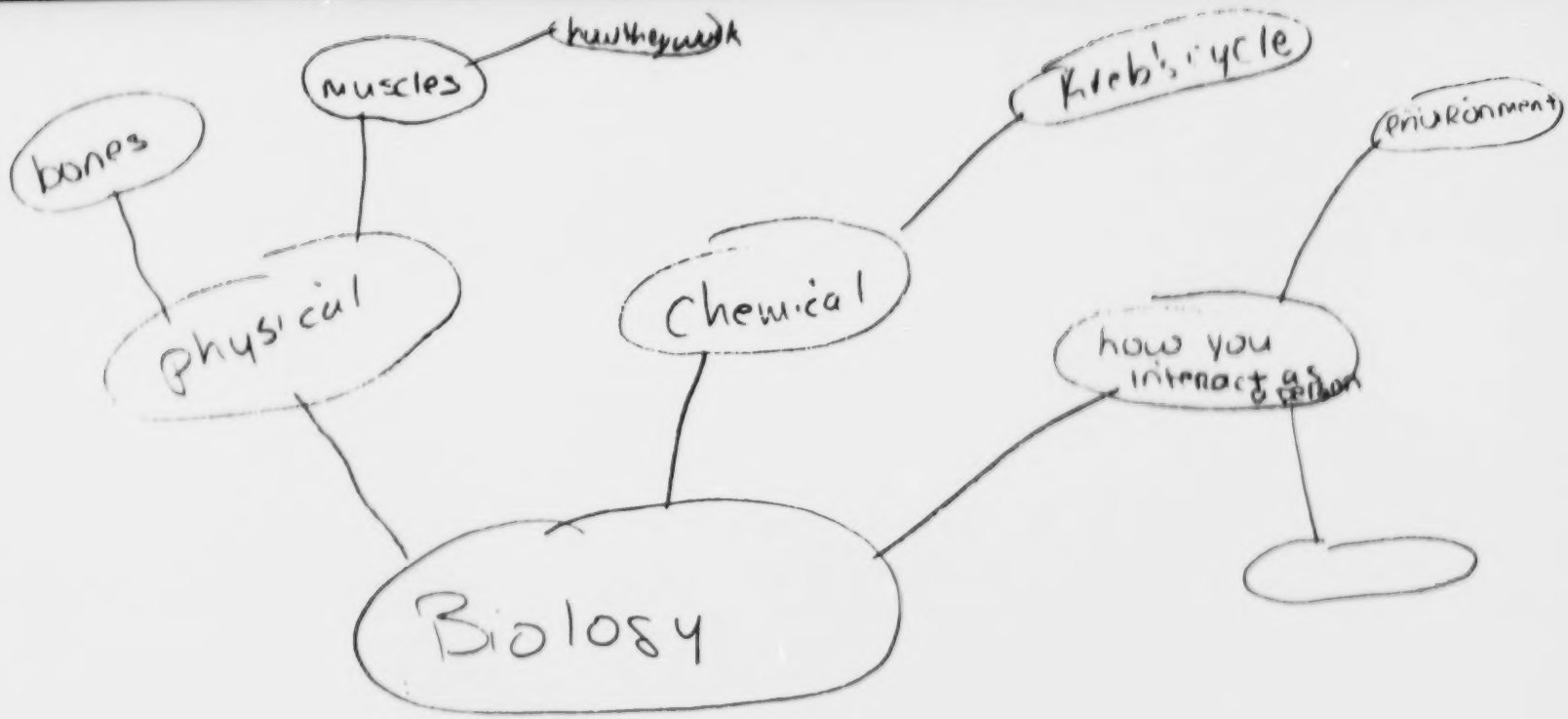
muscles
bones
Krebs cycle
environment
physical
Chemical
how you
Biology

Figure 5

During another class Marilyn quizzed students concerning the kind of weather a low pressure system, and then a high pressure system would bring to an area. When students gave wrong answers Marilyn did not correct them. She also failed to explain why, or the mechanism that would cause that particular weather. She ignored students when they asked, "What are millibars?" and "How do radio waves affect the ozone layer?"

Misinformation verbalized by Marilyn included the following: high pressure means the density of the air is falling; increasing air pressure indicates low pressure and sunny weather; and she incorrectly described an aneroid barometer.

During the final interview Marilyn stated she gained all her knowledge of weather from personal experiences: she did not have any university classes on meteorology or weather. She felt this level of knowledge was sufficient and was unaware of her misconceptions.

During the final interview Marilyn chose to diagram weather concepts because she said she felt comfortable teaching it and it was "fresh in her mind." (See Figure 6).

As she drew she talked.

> You have the atmosphere. You have two parts of the atmosphere. You have air and water. You have three parts of air. I'm not the greatest drawer in the world. You have oxygen, carbon, and it's 20, 21% depending on the book you look at, and carbon, nitrogen, and...Carbon is like carbon and argon and add up to 1%. And like it's 79% nitrogen, and the atmosphere, it can consist of a lot of things, air. You can take oxygen, carbon, nitrogen. Talk about all the different reactions you can have. Oxygen and how you breathe in oxygen and give off carbon dioxide, and nitrogen also. You can go into how you can have rust on them also; what would happen if you would have more oxygen in the air; how much faster things would rust; how fast things would burn.
>
> And then you have water, and you have these different types. You have solid, liquid, and gas. And all these are in the atmosphere and this is how you have your weather, the interaction of all these. You have the solid, the clouds which are in the atmosphere and then the troposphere. All these clouds are in the troposphere and how all this interacts together. You have your solid as snow, sleet and then liquid is rain. And then gas forms are fog, and they can see that to begin with. Then you can go into how everything works together. Yea, I feel more comfortable with this weather unit. And I can tell my knowledge with this weather unit is a whole lot better than

Atmosphere – Troposphere

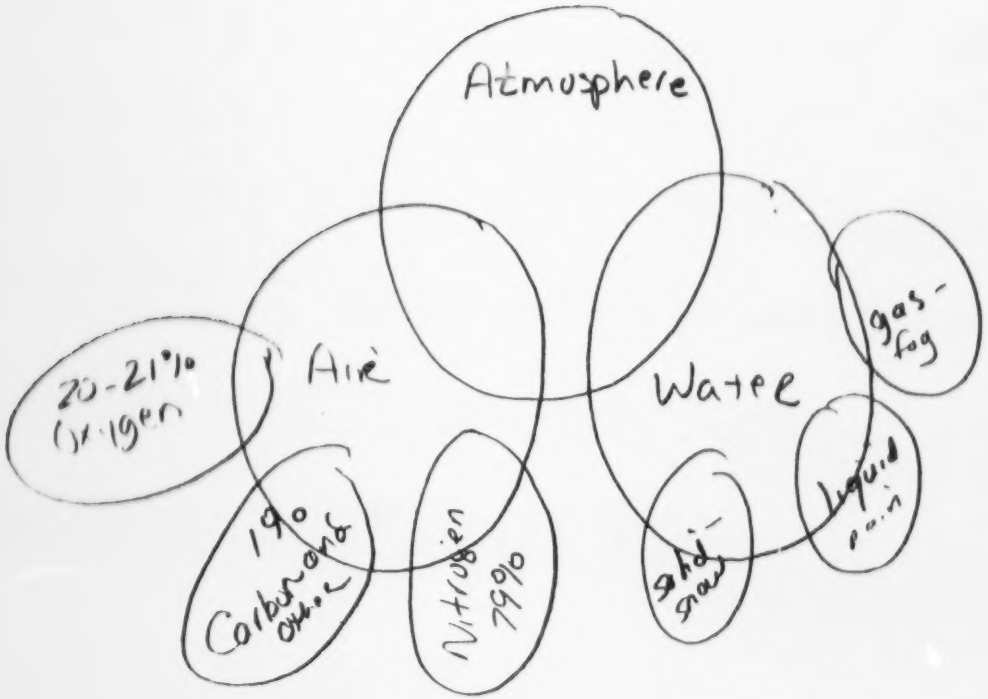

Figure 6

my unit with forces and motion.

Marilyn explained how she prepared for class: she took notes from a textbook and wrote down questions that she wanted to ask in class. "I write it down and then have it in front of me when I talk in class. · I don't have enough confidence to speak without notes in front of the kids." She reported that one of her biggest problems was never knowing what kind of questions the kids were going to ask. She felt that often their questions put her "on the spot."

As expected with Marilyn's lack of subject matter knowledge, she often verbalized that she did not know how to present concepts to the students.

Her cooperating teacher commented that Marilyn was so preoccupied with facts that she lost sight of how to promote student understanding.

> I've tried to show her that there are many different ways to give information to the students - that was suppose to be the point of today's lesson, guiding the students to find their own information and applying some common sense to it. That was supposed to be the purpose of the chart. But Marilyn got so hung up on facts that she lost sight of the major concepts.

By Marilyn's own admission she took facts directly from a book, placed them on an overhead, or had the students read the facts directly from the book. Except for two occasions class activities were supplied by the cooperating teacher or the other seventh grade science teacher. On these two occasions Marilyn used two activities from her science methods class. She presented the activities in a very structured manner, actually doing the activity step-by-step as a demonstration prior to the students doing the activity. During the lesson she had problems connecting the activity to class content. Marilyn was absorbed by mechanical details of executing the activities and missed the point behind doing the activity and what the students should gain from the exercise.

Laura

During the pre-student teaching interview Laura reported that her university level science courses included one semester of each of the following: biology, geology, environmental biology, chemistry, and astronomy. She recounted that she elected not to take physics because she found chemistry difficult. She felt physics would be impossible for her to pass.

She described her university science courses as lecture courses. According to Laura only environmental biology and astronomy had a laboratory component. One deficiency Of her

subject matter preparation, she identified, was the lack of lab courses.

> I think we should have had the labs. I think you look at things differently when you had the lab. We need more labs to do the hands-on. They don't want us to lecture to our kids, so why are all our classes lecture. I think they need special science classes for teachers that are different from the ones everyone else takes. A lot of science classes give things I don't use.

Although she stated that she felt confident teaching her first science unit, rocks and minerals - she had recently completed a geology course - she elected to draw her subject matter diagram on astronomy during the pre-student teaching interview. (See Figure 7).

She wrote the word planets above astronomy and drew lines radiating out from both planets and astronomy. The relationships between concepts appeared unclear and when I prompted her to explain the diagram she was unable to explain the relationships or give reasons why she placed the concepts as she did.

Examples from classroom observations

During classroom observations of her science classes I noticed the knowledge she presented to the students was often superficial and incomplete. For example during a lesson explaining animal adaptation she wrote on the chalk board,

> Polar bears adapt to ice fields and snowy areas.
> Plants and animals that live in the desert have adapted to heat and little moisture.

There was no mention of *how* the animals had adapted to these conditions. During a subsequent activity students researched a variety of environments, identified animals that lived in that environment and the conditions needing special adaptations. Animal structures and behaviors which allowed them to live under such conditions were not identified.

Also, neither the teacher nor the students made any distinction between the river environments in moderate and tropical climates. Students listed beavers, hippopotamuses and flamingos as living together. Laura made no correction nor gave any explanation.

On another occasion Laura made reference to *four* great oceans and said, "flying fish eat other animals" and "plants eat oxygen." In a subsequent activity students constructed food chains and made a number of errors the teacher failed to correct (e.g., small fish consuming frogs).

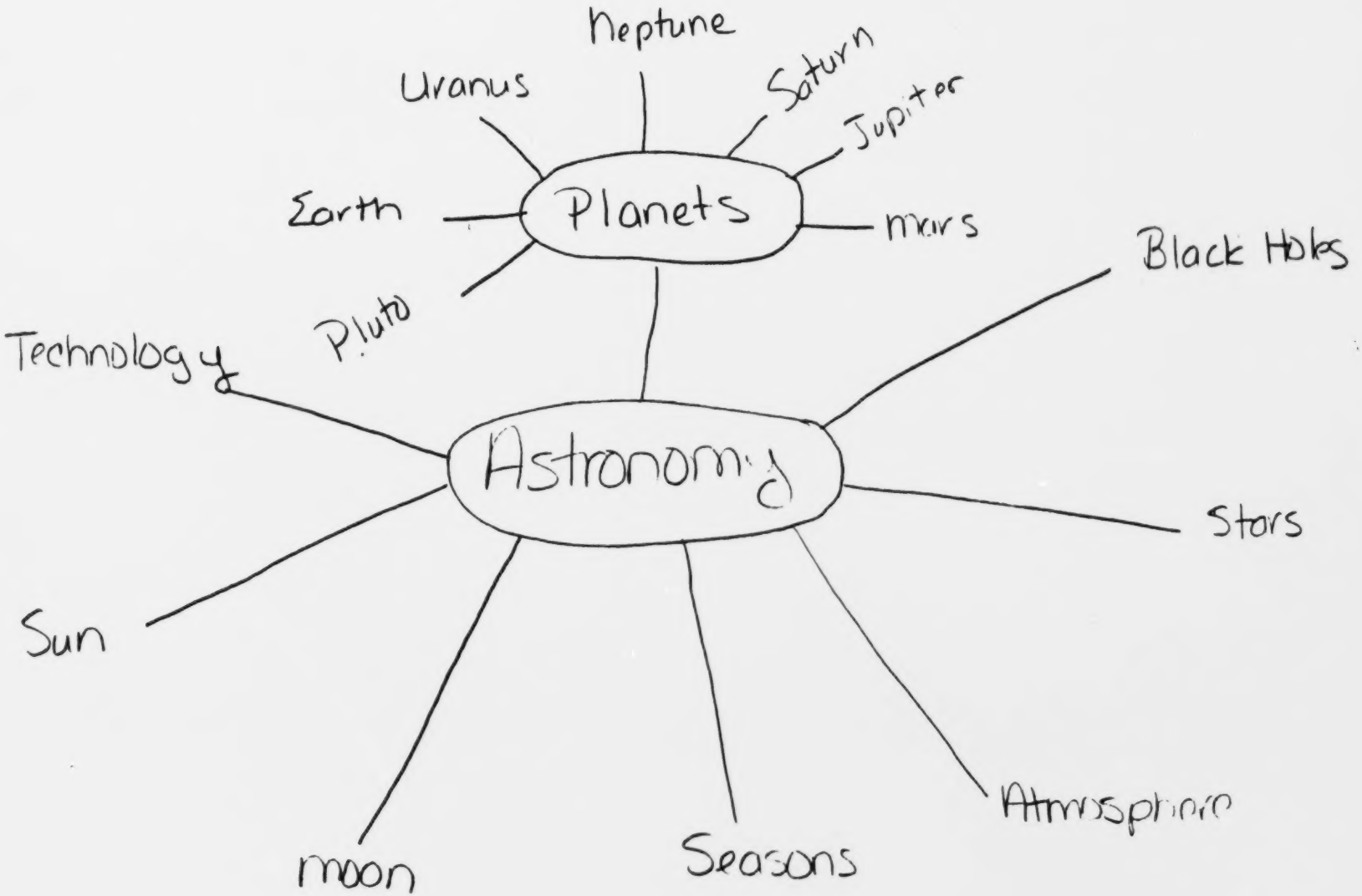
Neptune
Uranus
Saturn
Jupiter
Earth
Planets
mars
Black Holes
Pluto
Technology
Astronomy
Stars
Sun
moon
Seasons
Atmosphere

Figure 7

Laura elected to diagram the unit she taught on *rocks* for her second and last diagram of an area of subject-matter knowledge. She seemed to have the same problem organizing and indicating relationships between concepts that she had in her original subject-matter diagram. (See Figure 8).

Laura often stated that she was uncertain *how* to teach a concept or *what* the students were to gain from a lesson. Theresa, her cooperating teacher, also commented that Laura did not recognize *what* students were to gain from a class.

Practice

The purpose of looking at student teacher practice is to determine if and how student teacher beliefs translate into classrom practice, as well as to determine if there was a mismatch between the beliefs student teachers profess and their actual classroom behaviors and practices.

Marilyn The following vignette of a classroom situation during the final week of student teaching demonstrates how Marilyn's struggle with class management prevented her from executing a SPRSE lesson. The experiment, designed and executed by the students, was the culminating activity for the unit and the end of unit student assessment.

Vignette: Science Class

The student teacher, Marilyn, walks over and flips on the overhead projector light. The question, What will roll down the hill faster a ping pong ball or a basketball? appears on the screen at the front of the room. Marilyn directs the students' attention to the question but is interrupted by a group of students talking loudly about an incident that happened at school yesterday. She stops and corrects the students, "If you don't quiet down, I'll make you write questions from the book!" A student in the back of the room responds loud enough to be heard by the rest of the class, "She won't make us do it. She's a whimp!"

Marilyn explains that she wants each group to design and perform an experiment to answer the question presented. They are to collect data and decide on a format to present their results to the class. She explains that this activity will serve as their final assessment on the unit and will take the place of a test. Marilyn directs the students to "get into their groups and start working." Again she threatens to suspend the activity and have the students write if they do not get to work.

While the students are working in groups Marilyn passes out ping pong balls and basketballs. Many of the students begin bouncing and rolling the balls. Two or three groups appear to be working but the majority of the class is either talking about other non-science activities or playing with the balls and other

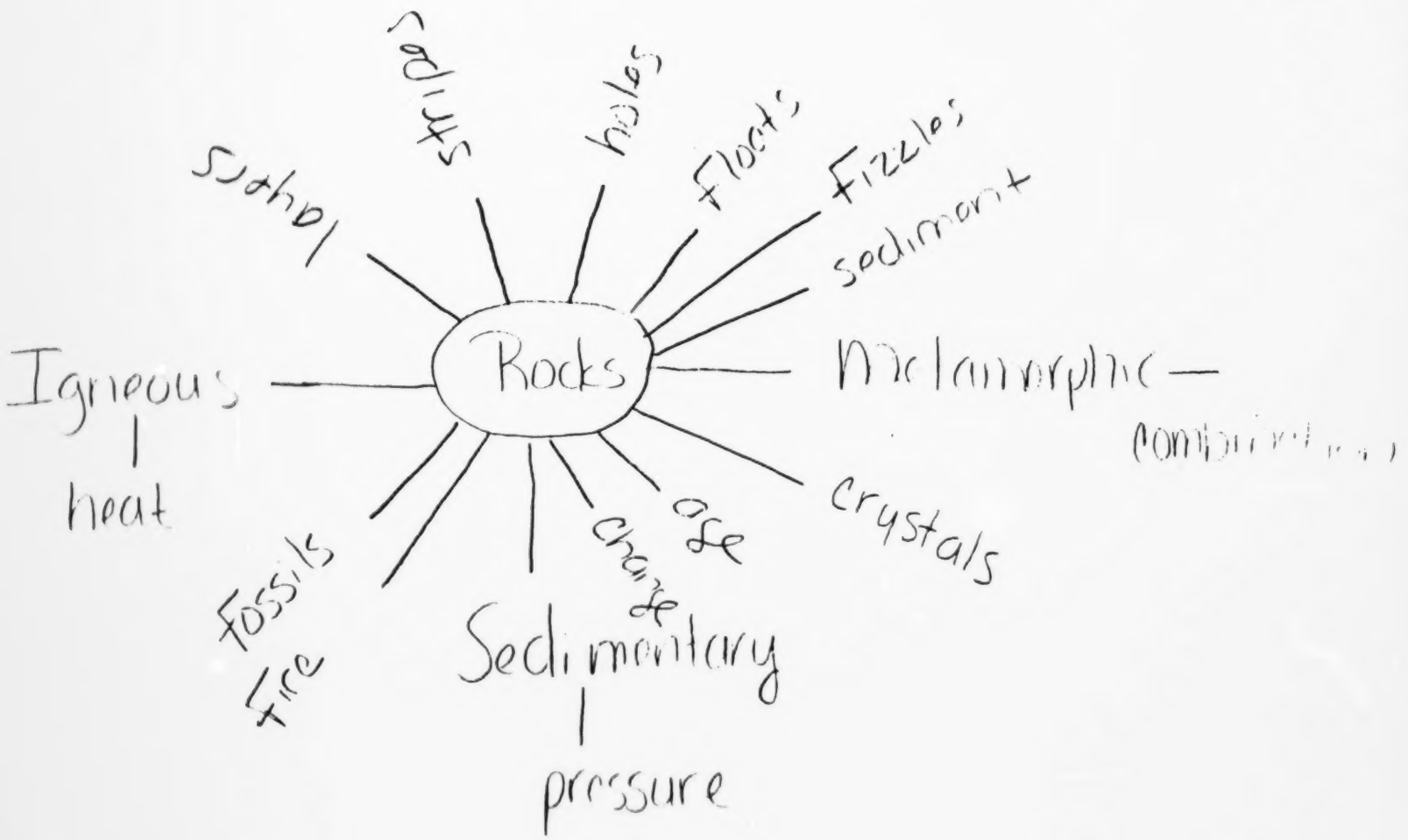
Rocks
Igneous
heat
Sedimentary
pressure
Metamorphic —
crystals
solid
stripes
holes
float's
fizzles
sediment
fossils
fire
age
change

Figure 8

equipment in the room.

Marilyn circulates from group to group, encouraging the students to "get to work" with few results. The students return to their off task behavior as soon as the student teacher moves to the next group.

Although the original intention of the lesson, to present a problem and have the students design and conduct an experiment to solve the problem, matched the philosophy of the science reform project the goals were never met because of class management problems. The class degenerated into pockets of noise and the students were playing with the equipment that had been placed on the tables in anticipation of the activity.

At other times during the semester I observed the student teacher attempt activities that demanded student involvement and problem solving, only to have the original activity altered by student behavior or the anticipation of behavioral problems. Reports from the cooperating teacher and university supervisor confirmed my observations. The following situation describes the science class in the preceding vignette several days later.

Vignette: Science Class: Later that Week

Marilyn introduces the lesson by stating, "We're going to do an activity. I'll do the activity first. You watch me and then you'll do it."

She calls on a student to read the purpose of the activity from a hand-out that she passed out earlier. This is followed by a second student reading off a list of materials. The student teacher holds up each piece of equipment as the student reads its name. She then calls on various students to read each step of the procedure. She performs each action as the student reads it. While this is going on students are throwing paper wads, talking loudly, hitting one another with rulers and generally not paying attention.

After Marilyn has completed doing the lab step-by-step, she instructs the class to do the same lab activity in their groups. Few groups do the lab. Most of the students use this time to socialize and engage in disruptive behaviors.

The cooperating teacher reported that often the student teacher was unsure of how to respond to classroom behavior so she simply ignored the disruption, going on with the class as if it were not happening. I also noted this behavior in my observations of Marilyn's classes. Because of problems with classroom discipline the student teacher shifted from lessons involving student activities to more traditional lessons of students answering questions and filling in charts and diagrams.

Other behaviors noted during classroom observations included the following: the use of an overhead projector to give information to students; requiring students to copy definitions, charts, and diagrams from the overhead transparency; and attempts to conduct a dialog with the students. "Verbalization with the students" was an effective strategy for her cooperating teacher, but given the student teacher's classroom management problems and struggle with the subject matter, this approach was extremely difficult for her, as illustrated in the following example.

Marilyn: What are we trying to find out?
Do you know what we're trying to find?
Student: To see how far water would rise.
Marilyn: What is the purpose of the lab?
[silence]
Look at the name of the lab to find the purpose.
[Marilyn calls on a student to read the name of the lab.]
Why did the candle go out?
Student: I don't know.
Another student: no oxygen.
Marilyn: What do you think would happen to the water level?
[silence]
Can you tell me why the water level would rise?
Student: The oxygen was used up.
Marilyn: What other gases are left in there?
Student: Carbon dioxide
Second student: smoke
Third student: nitrogen
Fourth student: air

Having students answer questions or going over questions which they had already answered became common practice in her class. Student work often involved answering questions on worksheets or review sheets. Most often questions began with the words: list, name, what, or how interspersed with some explain or describe questions.

Generally Marilyn's classes followed the pattern: present information by students reading information from a textbook or the overhead; "verbalization" with the students (usually this was a failed attempt because of discipline problems); a student activity (cooperative or individual); and finishing with students copying information - definitions, terminology - from the overhead or a book.

Laura Laura's lesson plans and class presentations followed the six point lesson plan: focus and review, statement of objective, teacher input, guided practice, independent practice, and closure - a lesson formula which reportedly was advocated in her methods classes.

Teacher input occupied a large percentage of class time. In about 50% of the classes (data obtained through classroom observations and lesson plans) Laura already had notes on the board when the students entered the room. During class she would read the notes aloud and have the students copy the notes. independent practice consisted of a homework assignment such as the following: the students writing a paragraph about rock changes, students collecting rock and soil samples at home, or students completing a worksheet.

During closure Laura would either ask a student to summarize what they did in class that day or ask various student questions about the class activity or notes. On a few occasions the students reviewed definitions for closure.

Laura obtained the activities she used from a variety of sources: activities from methods classes, textbooks and lab manuals obtained from the university library, convention materials, and Project Wild (She attended a ten hour training session for this project). But she seldom used SPRSE materials. She explained that the school did not have the necessary materials and that many SPRSE activities were unrealistic (e.g., taking students out of the classroom for outdoor experiences or field trips). Laura expressed her opinion that taking the students out of the classroom would mean a loss of student control.

Test questions usually asked students to recall the notes they copied from the chalk board. Samples of test questions included the following:

List the layers of the soil.
List the layers of the atmosphere.
Name the gaseous layer that covers the earth and acts like a blanket.
Where is the ozone layer located?

She also used a matching format in which students matched vocabulary words with their definitions.

Discussion

Student teachers' beliefs about teaching and learning were overshadowed by problems with classroom management and discipline, as well as limited subject-matter and pedagogical content knowledge.

Marilyn never really got at "how to teach" or "how students learn" because she was never in control of the class and Laura was afraid to "let the kids go." For example in an activity each student received the name of a plant or animal on an index card and roamed areound the room identifying other students with whom

they could make a food chain. Laura admonished the students that there was to be "no talking" during the activity. The emphasis, without exception, was on procedures and discipline.

Marilyn attributed classroom management difficulties to the students having problems. Several times she mentioned societal problems that exerted influences on the students. In her opinion the teacher was powerless to reach these students. She was convinced that her size and soft-spoken voice were factors she could not overcome. Her opinion was reinforced by people in her life she respected, her father and her fiance. At the end of her student teaching experience Marilyn declared that the greatest influence on her decision not to continue in teaching was the students.

> The students. Really seeing what's involved in middle school students, and seeing how middle school students act. I really had this different outlook on how middle grades students were going to act when I came here.

She went on to explain how she thought the students would be before the experience.

> Well, I thought they were going to be at least a little bit interested. I respect my parents and when my parents tell me to be quiet, I shut my mouth. I thought that the middle grades students were at least going to respect you in the manner that you were the teacher and when you asked them to be quiet, they would stop and they would have paper and pencil out when you asked them to. You wouldn't have to go over and open books to pages that you want them to be on.

Marilyn stated that her view of a teacher had changed.

> ...to be a teacher you have to be more aggressive than I can be. I'm more of a nicer person, but I just can't be aggressive toward people. It's not my personality to be an aggressive or forceful person. I didn't know that was involved in teaching. I thought you could be nice to them (students) and they'd be nice back to you. Excuse me that's not how it is. You have to be mean to them. That's how it is. I never thought it was going to be that way.

Both Marilyn and Laura attributed the failure of the student teaching experience to an unrealistic view of teaching and of students from their university experiences, as well as, their own early school experiences. Often Marilyn talked about how she remembered herself as a middle school student and her dismay that her own students did not behave in the same manner. They also stated that university education courses stressed making classes fun and interesting, but did not make them aware that many

students would not be interested in what they had to teach. Marilyn thought placement at a SPRSE site, which also had a reputation of being a "good school" with high test scores, would be a good placement for her student teaching experience. Laura's cooperating teacher, Theresa, expressed her feeling that Laura came into student teaching with an unrealistic view of teaching.

> ... and the education classes, the general education classes, they're teaching us an imaginary world. All the ones (student teachers) in my class that were gung-ho are giving up teaching. Like this cooperative learning thing, you have to have them in groups of three or it doesn't work. They (university instructors) told us to use larger groups, but they don't work.

Marilyn recognized her lack of subject matter knowledge as a liability during the first half of the semester but stated that her knowledge of weather was sufficient. Laura felt that a lack of laboratory experiences in her teacher preparation left her unprepared to teach SPRSE Science. Although, throughout the semester both student teachers verbalized their struggle with "how to teach," they failed to view their lack of subject matter knowledge as contributing to this problem.

The student teachers began their experiences with the reform project with less preparation in the major elements of SS&C than the experienced teachers who originally implemented the project. They had the benefit of a two week summer institute in which they were introduced to the principles of the reform, gained some experience with the associated teaching strategies, and became involved with collaboratively writing reform curricula. The student teachers had not attended the summer institute nor did they receive the university support accorded the classroom teachers when they began implementing the project. In addition neither student teacher had the benefit of a student teaching seminar or discussion group with other student teachers or teachers.

Two university instructors reported that they discussed the reform in the pre-service teacher education courses. One instructor, Mr. Evans, admitted that he mostly presented SPRSE teaching strategies by modeling them to the students rather than having any discussion. He stated he tried to make his university classroom as much like a reform classroom as possible, but his course, Classroom Management, did not lend itself to an in depth discussion of SS&C and/or SPRSE principles.

At the end of the student teaching experience Laura taught an Ecology unit using Project Wild activities. She reported that she had participated in the Project Wild training sessions. She said she liked the lessons, knew what to expect and was more

comfortable with the student activities and allowing the students to work together. She felt the Project Wild materials gave the teacher more guidance, especially the time needed for an activity, than SPRSE materials. When Laura was teaching Project Wild activities her teaching encompassed more of the teaching behaviors and strategies advocated by the science reform project than when she was actually teaching SPRSE. Laura's experience with teaching Project Wild provides some insight into the benefits which could have been derived from providing student teachers with similiar preteaching experiences with the SPRSE reform.

Conclusion

Previous to student teaching Marilyn and Laura, the student teachers in this study, expressed very idealistic views of teaching and learning. But many of their ideas changed when faced with keeping the students' attention and coping with classroom problems on a daily basis. Both student teachers reverted to a teacher-centered model of instruction and viewing science as a body of facts to be presented to their students.

Student discipline issues at the two sites were a major factor which dispelled many of the student teachers' beliefs concerning increased student involvement in the classroom and created an issue that they could not resolve. To them it was a choice, class control or the reform project.

The most significant determining factors of how the student teachers taught were their comfort with the subject matter and materials and concerns of classroom management and student control. Their beliefs about teaching and learning had shifted from a focus on how students learn (prior to student teaching) to how teachers should teach (at the end of the experience). During informal discussions at the end of the experience, Laura expressed her belief that students need drill and practice--because that was how she learned--and the value of a quiet, orderly classroom. Marilyn was less articulate concerning her beliefs about teaching and learning at the end of the experience. She expressed her frustration with the students and talked about her efforts to regain control of the classroom. Even when prompted she refused to discuss how students learn. Both student teachers' practice at the end of the experience reflected this shift toward teacher-centered instruction.

Although reform programs were operating at both schools, the student teaching situations were not different from traditional classroom situations. The student teachers were not actively involved with any of the changes advocated by the reform, and no opportunities were provided for reflection.

In this study the reform project curriculum was expected to

be a driving force which would influence the school and the students. In reality the school (especially the teachers) and the students had a profound effect on the manifestation of the reform project in each classroom--including the student teachers' classrooms. The cooperating teachers were a powerful influence during the field experience. Their beliefs were communicated to the student teachers in their charge and their practice served as a model of how to teach. Both cooperating teachers focused on the mechanics of the program, and student discipline.

The experience with the reform project had the effect of "turning these student teachers off" to educational reform efforts, especially SS&C science and teaching in general.

Implications for Teacher Educators

With the current movement for educational reform in this country there exists a need for teachers who "teach differently." The problem is how to produce teachers who have the beliefs, knowledge and practice which are consistent with today's reform efforts. One thought is to expose pre-service teachers to these ideas early in their teacher preparation programs and have them engage in practice teaching in schools participating in the reforms.

Selection of schools for field experiences. In order to derive maximum benefit from such a teacher preparation program the schools must be carefully selected to be certain that a true reform environment exists. Cooperating teachers and university supervisors must be carefully screened to provide support personnel for student teachers as they try to implement the reform. Cooperating teachers and university supervisors who do not "buy in" to the reform can send conflicting messages which can undermine the student teachers' progress. Such personnel also need to be trained to deal with student teachers' problems and have time in their schedules to conference and work with the student teachers. Like teachers trying to implement reform in their classrooms, student teachers also need a support structure to help make the transition from traditional teaching strategies to the student-centered classrooms advocated by many educational reforms. Today's aspiring teachers are still the product of a traditional teacher-centered classroom, what Lortie (1975) called the "apprenticeship of observation". As documented in the literature and evidenced in this study the impression of these twelve years of experience in the public school system is difficult to overcome.

Student teacher preparation. Student teachers need to be adequately prepared for subject matter and pedagogical challenges they will encounter in teaching. Schools of education need to look carefully at their particular subject matter requirements, analyzing the number of courses required and the content of these

courses, and making changes if their requirements seem insufficient. Student teachers who must struggle with content have an extra burden as they endeavor to manage a classroom and deal with the many facets of student instruction and learning.

Today there are a number of different teacher education programs, each with its own underlying philosophy, values and benefits. In order for any teacher education program to be effective, the *total* teacher education program--classes, practicums, student teaching and other experiences--must be truly integrated, give aspiring teachers practical experience throughout the program, and be internally consistent. Conflicting messages can undermine an otherwise, good program and yield undesirable results.

A dilemma of student teaching at a reform site. A danger is that the student teaching experience in a reform setting will be such a bad experience that the student teacher decides not to teach in that manner, or not to teach at all. Instead of convincing the student teacher to teach *differently* it could reinforce Lortie's "apprenticeship of observation" and cause the aspiring teacher to teach as he/she was taught.

Learning to teach is a complex process. Many factors influence the future teacher. Although some are out of the control of teacher educators, the field experience can be carefully constructed to reinforce beliefs about teaching and learning advocated in pre-service education courses. The alternative is for the field experience to undo any progress made in changing the attitudes of future teachers.

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